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SELECTING SPRING WHEAT FOR IMPROVED COMPETITIVE ABILITY - PROOF OF CONCEPT

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"Selecting spring wheat for improved competitive ability - proof of concept"

Final Report

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ABSTRACT

As part of this project we successfully conducted a series of nine replicated trials over the course of two years. Significant genotypic differences were detected for wheat grain yield in all trials. The pooled correlations (across four experiments) between weedy wheat yields and oat and mustard yields were r =-0.49** and -0.67**, respectively. This suggests that higher yielding wheat lines were doing this at the expense of weeds. The results of a cross-testing experiment conducted at Saskatoon in 2009 and 2010 indicated that early generation selection under model weed conditions was no more effective than selection under conventional conditions. However the results from the 2010 experiment conducted under organic versus conventional conditions at Edmonton indicated that there was an advantage for the lines previously selected under model weed pressure. The absence of weeds in the organic plots at Edmonton, due to severe drought in 2009, limits the scope of our conclusion. In light of these results, it would be prudent to re-test some of the material evaluated during the course of this project in future organic vs. conventional cropping system trials in order to obtain a larger data base that might provide firmer conclusions.

1.0 INTRODUCTION
1.1 Background Information:

The North American organic industry is growing by 15-20% annually, amounting to greater than $15 billion in consumer purchases. Organic foods ($13.8 billion) accounted for 2.5% of the total U.S. food sales that year (Source: OTA's 2006 Manufacturer Survey). Assuming Canadian sales at 10% of U.S. levels, the organic bread and grains category in this country generates $136 million/annum. Media stories (spring of 2008) indicate that organic production can't keep up with demand. At the same time we are seeing rapidly escalating crop input prices tied to fossil fuel prices. Breeding wheat varieties that are more efficient in the use of environmental resources will benefit not only organic production but could benefit producers using conventional inputs. Cultivars that are more competitive are conducive to use in IPM systems and will lead to more efficient nitrogen and water use by supressing losses to weeds. We demonstrated in a ADF-supported three-year evaluation of registered spring wheat cultivars that there are repeatable genotypic differences. We want to confirm whether we can make gains over conventionally-bred cultivars by selecting segregating breeding populations under weedy conditions.

The initial research conducted at the CDC used experimental lines which had contrasting plant morphologies (Huel and Hucl, 1996). From there we used the protocols on registered spring wheat cultivars (Hucl et al 1997) to demonstrate that varietal differences existed in commercially available and adapted material. Furthermore, we demonstrated that our controlled model weed pressure protocol correlated with what happened with "real" weeds. Subsequently, we tested a wider range of more recently grown spring wheat and durum varieties (Hucl ADF project 2003-2008). The current project is a logical next step in that we are determining whether our selections from segregating breeding populations under weedy versus non-weedy scenarios differ signficantly in competitive ability and whether any progress can be made via plant breeding.

As part of ADF Project#20030109 (Spring Wheat Cultivars for Organic Production) we selected 22 spring wheat breeding populations under model weed pressure versus weed-free

conditions for four consecutive generations, starting in 2004. The 22 breeding populations were from the CDC Bread Wheat (CWRS class) breeding program.

Wheat lines in the F7 generation were evaluated under weedy (n=1110 lines) or non-weedy (n= 1100 lines) conditions in microplots in 2007. Selection pressure (15% retention) was applied to the populations and this material (180 lines) was tested in replicated trials in 2008 at the University of Saskatchewan's Kernen Crop Research Farm. Each trial consisted of 90 experimental lines and six check cultivars.

The objective of this two-year project is to determine whether the CDC selection scheme under weedy versus weed-free conditions was effective.

The information from this project will help determine whether breeding spring wheat specifically for organic production or low-input scenarios is realistic. This research would help us conclude whether it is realistic to run a parallel breeding effort under weed-pressure as opposed to selecting the lines using conventional practices.

2.0 MATERIALS AND METHODS

Field protocol:

In 2009 and 2010 we evaluated 36 lines wheat lines that performed best under weedy conditions as well as 36 lines that performed best under weed-free conditions in trials conducted at Saskatoon 2008. In order to assess the effectiveness of the five years of selection pressure we cross-tested the 36 lines. In other words, the 72 lines (plus 6 check cultivars) were grown under both weedy and weed-free conditions in replicated trials. The trial format was a four-replicate RCBD with a plot size of 1.2 x 3.6 m. This experiment was conducted at the Kernen Crop Research Farm using protocols adapted from Huel and Hucl (1996). The weedy and non weedy reps were randomized. The experiment was sown on May 26th, 2009 and June 15th, 2010. A second experiment was designed to evaluate 32 lines selected using the model weed protocol in earlier generations and grown in unreplicated 'weedy rows' in 2008. This 2009 experiment was sown under weedy conditions and consisted of a two-rep RCBD. A third experiment, also using a 2-rep RCBD evaluated 32 lines selected in parallel using the conventional 'non-weedy' protocol. This 2009 experiment was grown under non-weedy conditions. Field replications for these two trials were limited by seed availability. In 2010 we cross-tested the most promising lines from the 2009 2 rep trials using a four replication RCBD. A total of 22 lines were evaluated in the 2010 trial (6 check cultivars, 8 lines selected under weedy conditions and 8 lines selected under non-weedy conditions).

Seeding rates: the wheat target rate for the all trials was 1,200 seeds per plot. Seeding rate was not adjusted for germination as it was greater than 95% based on a random sub-sample of lines tested. Seeding rate was, however, adjusted for seed weight.

The harvested plot size for all Kernen trials was 3.66m x 1.22m (4.46m2). The model weeds, tame oat (cv Morgan) and mustard (cv Cutlass), were sown at a target rate of 55 plants/m2 for each species to compensate for shallower seeding and a potentially dry seed bed. Seeding rates of the model weeds were adjusted for seed germination level.

The model weeds were sown slightly shallower to avoid mixing by the seeder and were sown perpendicular to the wheat. The non-weedy reps were driven over with the seeder in the

ground to provide equal soil packing and disturbance for both weedy and non-weedy plots. The model weed seed was treated with an insecticide to control flea beetles.

Fertilizer consisting of 11-51-0 for the wheat plots was applied at 48 kg/ha. No fertilizer was applied with the model weeds.

The non-weedy treatment was treated with Horizon and Buctril M with Score adjuvant at recommended rates once during the growing season.

Two trials (Organic versus Conventional crop rotations) were grown at the University of Alberta at Edmonton (AB) in each year (2009 and 2010). Both trials consisted of a four-rep RCBD with 38 entries. The entries consisted of a subset of the 72 lines cross-tested in the larger experiment conducted at Kernen in 2009 and 2010. The Edmonton trials consisted of six row plots with a row spacing of 22.5 cm and row length of 4 m. Both trials were seeded on May 13th in 2009. In 2010 the Organic trial was sown on May 18th and the Conventional trials on May17th. The 2009 conventional trial received two applications of fertilizer (first = 46 kg/ha of 46-0-0; second = 36 kg/ha 11-52-0) and weeds were controlled with an application of Buctril M. In 2010 the Conventional trial received a seed-placed application of 50 kg/ha of 11-52-00 fertilizer and weeds were controlled with a single application of Buctril M.

Grain sample processing for yield trials and bulk plots:

Grain samples were run over a 26 hole riddle and a 5/64 round sieve in a Carter-Day dockage tester. The air flow was set to remove a maximum amount of chaff without removing any mustard seed. The oat was separated by the riddle, with the wheat going through the riddle and the oat going over the top, the mustard was then separated by the 5/64 round sieve, with the wheat going over the riddle and the mustard falling through. The amount of wheat falling through the 5/64 round was of a trace amount. The riddle did not remove all of the oat seed; therefore we had to calculate for the remaining oat in the sample. We did this by taking a 200 g representative sample for each plot, hand separating the oats out of it and then calculating the percentage of oat in the 200g sample and applying that percentage to the remaining sample. A vertical air flow column separator was used to separate a majority of the oat seed from the wheat in the 200g sample, prior to hand picking of the sample.

3.0 RESULTS

The pedigrees of the 72 lines selected for the cross-testing experiment are presented in Table 1. The lines are from crosses involving registered CWRS cultivars such as Infinity (BW799), CDC Alsask (W98332), 5601HR (BW256), 5602HR (BW297), CDC Go (BW781) and CDC Bounty. The P00.06 series lines are FHB or midge-resistance donors while the W series parents are CDC lines that made it to the Coop entry stage on the basis of agronomic performance but were dropped due to quality or disease issues. The lines W99171, W00219, and W00174 were evaluated as BW809, BW338 and BW331, respectively. Thus, the lines under evaluation are representative of material in a typical CWRS wheat breeding program.

In 2009, significant genotypic differences were observed for wheat yield under both weedy and non-weedy conditions as were genotypic effects on oat yield (Table 2). Mustard yields were more variable (CV= 34%) and the wheat genotypic differences were not statistically

significant. Weed pressure resulted in a 37% yield reduction. On average, the lines selected under model weed pressure (WEED lines) yielded 2.5% less than the lines selected under conventional conditions (NW lines) when both were evaluated under conventional conditions (Table 2). Under weedy conditions the WEED lines yielded 4.7 % less than the NW lines. Thus, the NW lines out-yielded, on average, the WEED lines under both weedy and conventional conditions. The WEED and NW lines did not appear to differ in days to heading, maturity or height (Table 2). This suggests that identifying lines better suited for production under weed pressure is no different under conventional conditions as under model weed competition conditions. Of the eight lines (Entries 9, 43, 44, 45, 48 50, 54, and 59) that yielded well under weedy conditions as well as ranking in the top quartile under conventional conditions, seven were from the conventional selection stream. Of the six check cultivars, AC Superb and CDC Bounty were the highest yielding under both test protocols. CDC Merlin and Lovitt were lower yielding under both test protocols while CDC Go ranked 8th for yield under conventional conditions but 43rd under weed pressure. AC Barrie ranked 52nd under conventional conditions but 8th under weed pressure.

In 2010, significant genotypic differences were observed for wheat yield under both weedy and non-weedy conditions as were genotypic effects on oat and mustard yield (Table 3). Weed pressure resulted in a 35% yield reduction. On average, the lines selected under model weed pressure (WEED lines) yielded 3.0% more than the lines selected under conventional conditions (NW lines) when both were evaluated under conventional conditions (Table 3). Under weedy conditions the WEED lines yielded 4.7 % more than the NW lines. Thus, the WEED lines out-yielded, on average, the NW lines under both weedy and conventional conditions in 2010, which was the reverse of what we observed in 2009. The WEED lines were, on average, a day later maturing and 2.5 cm taller than the NW lines (Table 3). Of the eight lines (Entries 10, 22, 32, 33, 44 45, 68, and 70) that yielded well under weedy conditions as well as ranking in the top quartile under conventional conditions, half were from each selection stream. Of the six check cultivars, CDC Go yielded the highest (11th) under conventional conditions but ranked39th under weed pressure. Lovitt was the highest yielding check under weed pressure (ranked 8th) and only second to CDC Go under conventional conditions AC Barrie ranked 43rd under conventional conditions but1 8th under weed pressure. Thus, there was a reversal in the performance of experimental lines (WEED versus NW) between 2009 and 2010 as well as a general reversal in the performance of the check cultivars. This could be due to the very different growing conditions encountered during the two crop seasons. However, the average yield reductions due to weed pressure were nearly the same (37 versus 35%) for the two years, indicating a high level of repeatability. Although the WEED and NW lines reversed their performance, on average, between years there was no evidence of interaction of selection protocol x weed pressure in either year. The conclusion from this experiment would be that from a weed competition standpoint wheat breeders could identify high yielding lines under conventional conditions which would also perform well under weed pressure.

The results for the two trials grown at Edmonton in 2009 are summarized in Table 4. The lines evaluated at Edmonton are a sub-set of those evaluated at Saskatoon. Severe drought at Edmonton in May and June of 2009 curtailed weed emergence. Thus, there was very limited weed pressure on the trial grown in the organic rotation. The organic trial yielded 17% less than the conventional trial, likely a consequence of soil fertility conditions. Of the eight lines that yielded the most under organic conditions, five were from the model weed selection stream while three were from the conventional selection stream. On average, the WEED lines yielded 2.3% less than the NW lines under conventional conditions but 1% more under organic conditions.

These results are quite different from those obtained in the 2009 Saskatoon model weed experiment (Table 2), and suggest that the model weed system selection scheme was effective. The differing results might have arisen because the lines selected for testing at Edmonton were a result of greater divergent selection pressure for yield under weed pressure or conventional conditions at Saskatoon in 2008. Three of the five WEED lines that performed well under organic conditions at Edmonton ranked in the top 10 under weed pressure at Saskatoon but did not rank well in the Saskatoon conventional (ie NW treatment).The three NW lines that ranked well under organic conditions at Edmonton also ranked well under weedy conditions at Saskatoon and one of those also ranked well in the NW treatment. Thus there appears to be some commonality between the Edmonton organic and Saskatoon weed pressure trials in that six out of eight (75%) of the more promising lines were identified at both sites in 2009.

The results for the two trials grown at Edmonton in 2010 are summarized in Table 5. Unlike 2009, high weed pressure was obtained in 2010. The organic trial yielded 55% less than the conventional trial and there was extreme weed pressure in that year due to ideal moisture conditions. Of the eight lines that yielded the most under organic conditions in 2010, five were from the model weed selection stream while three were from the conventional selection stream. This was the same ratio observed in 2009. In 2010, on average, the WEED lines yielded 0.7% more than the NW lines under conventional conditions but 16.7% more under organic conditions. These results show a similar pattern to those observed in 2009 in that the WEED lines expressed a higher yield differential in relation to the NW lines under organic conditions. Thus, over the two years of this study the Edmonton organic versus conventional production trials suggest that the model weed system selection scheme was effective while the Saskatoon model weed trials do not. Of the five WEED lines that performed well under organic conditions at Edmonton, one ranked in the top 3 under weed pressure at Saskatoon. Two of NW lines that ranked well under organic conditions at Edmonton also ranked well under weedy conditions at Saskatoon and one of those also ranked well in the NW treatment.

Four wheat lines that performed well in the 2009 cross-testing experiment were advanced to a 2010 cooperative organic wheat trial coordinated by Dr. Stephen Fox (AAFC-CRC). One of the four lines performed well in 2010 and was advanced for quality evaluation.

A new set of lines selected from the model weed (n=32) versus conventional selection stream (n=32) were grown at Saskatoon under weedy and conventional (NW) conditions in 2009 (Tables 6 and 7). Model weeds reduced wheat grain yield by an average of 57%. Of the check cultivars, CDC Bounty yielded the most under both test protocols, CDC Merlin and Lovitt yielded the least while AC Barrie ranked better under weed pressure relative to the conventional treatment (similar to the results in Table 2). AC Superb and CDC Go reversed their relative rankings in these two trials relative to the larger trial (Table 2). In 2010 we cross-tested the best 8 lines from each selection stream (Table 8). Weed pressure reduced wheat yields by 36% similar to the results for the larger experiment (Table 3). Of the check cultivars, AC Superb and CDC Go ranked best for yield under NW conditions while AC Barrie, AC Superb and CDC Go ranked best under weed pressure. CDC Bounty yielded the least under both test protocols, which was a reversal from 2009. Lovitt was intermediate in yield with both test protocols in 2010.The WEED lines yielded 9.4% and 8.8% higher than the NW lines under conventional and model weed pressure, respectively. The WEED lines were similar in maturity to the NW lines but, on average, 6 cm taller. Although we saw a larger yield differential between selection streams in this second model weed experiment, like in the larger experiment we did not observe a selection stream x weed management interaction.

Breeding populations under selection

A series of 13 spring wheat populations were grown in bulk plots in the F5 generation at Kernen in 2009 (Table 9). Single spikes were harvested from the first six populations and the remaining populations were combine – harvested. The harvested spikes were threshed individually selected for grain plumpness and a total of 2,636 lines were planted in weedy or non-weedy hills, for a total of 5,272 lines in 2010. Spikes were selected from approximately 10% of the hills. Spikes were harvested from the remaining seven populations that were grown in bulk plots in 2010 (Table 9).

Fifteen populations were advanced to the hill plot testing stage in the F6 generation in 2009 (Table 10). The nursery consisted of 7,568 hills grown under model weed pressure and 7,568 hills grown under non-weedy conditions (total of 15,136). In 2010, 2,548 lines selected from the 2009 hills were grown under weedy and non-weedy conditions (total of 5,096). Approximately 15% of those lines were harvested in 2010 for testing in a single-rep format in 2011.

The wheat lines selected in 2009 and 2010 under model weed conditions will be selected further under organic conditions, starting in 2010.

4.0 CONCLUSIONS AND RECOMMENDATIONS

As outlined above we successfully conducted a series of nine replicated trials over the course of this two year study. Significant genotypic differences were detected for wheat grain yield in all trials. In a majority of the trials conducted at Saskatoon the grain yields of the model weeds (oat and mustard) were affected by wheat genotype. The pooled correlations (across four experiments) between weedy wheat yields and oat and mustard yields were r =-0.49** and -0.67**, respectively. This suggests that higher yielding wheat lines were doing this at the expense of weed yield and were more competitive. The results of the cross-testing experiment conducted at Saskatoon in 2009 and 2010 indicated that early generation selection under model weed conditions was no more effective than selection under conventional conditions. However the results from the 2010 experiment conducted under organic versus conventional conditions at Edmonton indicated that there was an advantage for the lines previously selected under model weed pressure.

In light of the absence of a selection protocol by weed management (weedy vs. non-weedy) interaction in the cross-testing experiment one would conclude that the CDC selection scheme was not effective in identifying more competitive wheat genotypes. The 2010 organic vs. conventional cropping experiment suggest otherwise. Unfortunately, the absence of weeds in the organic plots at Edmonton, due to severe drought in 2009, limits the scope of conclusions on whether the CDC selection scheme was effective or not. In light of these results, it would be prudent to re-test some of the material evaluated during the course of this project in future organic vs. conventional cropping system trials in order to obtain a larger data base that might provide firmer conclusions.

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Administrative and other aspects

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Table 1. Wheat entries in the 2009 and 2010 cross-testing experiment (ORGYT#1) grown at the Kernen Farm, Saskatoon

Entry	NAME	PEDIGREE	2008 Source Test	2008 entry	cross
1	AC Barrie				
2	AC Superb				
3	CDC Go				
4	CDC Merlin				
5	Lovitt				
6	CDC Bounty				
7	08WEED1	BW297/W98332	08ORG2W-KER	7	X02.217
8	08WEED3	BW297/W98332	08ORG2W-KER	9	X02.217
9	08WEED5	BW297/W98332	08ORG2W-KER	11	X02.217
10	08WEED9	BW297/W98332	08ORG2W-KER	15	X02.217
11	08WEED14	BW297/BW314	08ORG2W-KER	20	X02.218
12	08WEED19	BW297/BW314	08ORG2W-KER	25	X02.218
13	08WEED23	BW297/BW799	08ORG2W-KER	29	X02.219
14	08WEED34	BW799/W98332	08ORG2W-KER	40	X02.228
15	08WEED36	BW799/W98332	08ORG2W-KER	42	X02.228
16	08WEED37	BW799/W98332	08ORG2W-KER	43	X02.228
17	08WEED40	BW799/W98332	08ORG2W-KER	46	X02.228
18	08WEED44	BW799/Alsen	08ORG2W-KER	50	X02.229
19	08WEED49	BW799/Alsen	08ORG2W-KER	55	X02.229
20	08WEED59	BW799/W00201	08ORG2W-KER	65	X02.230
21	08WEED63	BW799/W00219	08ORG2W-KER	69	X02.231
22	08WEED71	BW799/W00294	08ORG2W-KER	77	X02.232
23	08WEED85	BW799/W00347	08ORG2W-KER	91	X02.233
24	08WEED86	BW799/W00347	08ORG2W-KER	92	X02.233
25	08WEED100	BW799/W99171	08ORG3W-KER	16	X02.234
26	08WEED121	BW314/BW799	08ORG3W-KER	37	X02.244
27	08WEED126	BW314/BW799	08ORG3W-KER	42	X02.244
28	08WEED132	BW314/W98332	08ORG3W-KER	48	X02.245
29	08WEED134	BW314/W98332	08ORG3W-KER	50	X02.245
30	08WEED136	BW314/W98332	08ORG3W-KER	52	X02.245
31	08WEED138	BW314/W98332	08ORG3W-KER	54	X02.245
32	08WEED139	BW314/W98332	08ORG3W-KER	55	X02.245
33	08WEED146	Bounty/BW781	08ORG3W-KER	62	X02.19
34	08WEED147	Bounty/BW781	08ORG3W-KER	63	X02.19
35	08WEED148	Bounty/BW781	08ORG3W-KER	64	X02.19
36	08WEED149	Bounty/BW781	08ORG3W-KER	65	X02.19
37	08WEED152	BW 256/BW781	08ORG3W-KER	68	X02.28
38	08WEED161	BW 256/P00.05-86	08ORG3W-KER	77	X02.30
39	08WEED162	BW 256/P00.05-86	08ORG3W-KER	78	X02.30
40	08WEED176	BW 256/P00.06-77	08ORG3W-KER	92	X02.33
41	08WEED178	BW 256/P00.06-77	08ORG3W-KER	94	X02.33
42	08WEED179	BW 256/P00.06-77	08ORG3W-KER	95	X02.33
43	08NW6	BW297/W98332	08ORG4NW-KER	12	X02.217
44	08NW7	BW297/W98332	08ORG4NW-KER	13	X02.217
45	08NW15	BW297/BW314	08ORG4NW-KER	21	X02.218
46	08NW21	BW297/BW799	08ORG4NW-KER	27	X02.219
47	08NW23	BW297/BW799	08ORG4NW-KER	29	X02.219
48	08NW27	BW297/BW799	08ORG4NW-KER	33	X02.219

49	08NW28	BW297/BW799	08ORG4NW-KER	34	X02.219
50	08NW30	BW297/BW799	08ORG4NW-KER	36	X02.219
51	08NW42	BW799/Alsen	08ORG4NW-KER	48	X02.229
52	08NW48	BW799/Alsen	08ORG4NW-KER	54	X02.229
53	08NW51	BW799/W00201	08ORG4NW-KER	57	X02.230
54	08NW65	BW799/W00219	08ORG4NW-KER	71	X02.231
55	08NW68	BW799/W00219	08ORG4NW-KER	74	X02.231
56	08NW70	BW799/W00219	08ORG4NW-KER	76	X02.231
57	08NW72	BW799/W00294	08ORG4NW-KER	78	X02.232
58	08NW76	BW799/W00294	08ORG4NW-KER	82	X02.232
59	08NW80	BW799/W00294	08ORG4NW-KER	86	X02.232
60	08NW86	BW799/W00347	08ORG4NW-KER	92	X02.233
61	08NW96	BW799/W99171	08ORG5NW-KER	12	X02.234
62	08NW98	BW799/W99171	08ORG5NW-KER	14	X02.234
63	08NW104	BW799/W00174	08ORG5NW-KER	20	X02.235
64	08NW106	BW799/W00174	08ORG5NW-KER	22	X02.235
65	08NW109	BW799/W00174	08ORG5NW-KER	25	X02.235
66	08NW115	BW314/Alsen	08ORG5NW-KER	31	X02.238
67	08NW117	BW314/Alsen	08ORG5NW-KER	33	X02.238
68	08NW124	BW314/BW799	08ORG5NW-KER	40	X02.244
69	08NW125	BW314/BW799	08ORG5NW-KER	41	X02.244
70	08NW131	BW314/W98332	08ORG5NW-KER	47	X02.245
71	08NW135	BW314/W98332	08ORG5NW-KER	51	X02.245
72	08NW144	Bounty/BW243	08ORG5NW-KER	60	X02.18
73	08NW153	BW 256/BW781	08ORG5NW-KER	69	X02.28
74	08NW168	BW 256/P00.06-66	08ORG5NW-KER	84	X02.31
75	08NW170	BW 256/P00.06-66	08ORG5NW-KER	86	X02.31
76	08NW175	BW 256/P00.06-72	08ORG5NW-KER	91	X02.32
77	08NW177	BW 256/P00.06-77	08ORG5NW-KER	93	X02.33
78	08NW179	BW 256/P00.06-77	08ORG5NW-KER	95	X02.33

Table 2. Data for experimental spring wheat lines previously selected under contrasting conditions evaluated under conventional and controlled weed conditions at Saskatoon in 2009

Entry	Name	NW wheat yield kg/ha	Rnk	Weedy wheat yield kg/ha	Rnk	% redn	Rnk	DSE days	DPM days	Ht cm	Oat kg/ha	Must kg/ha
1	AC Barrie	4749	52	3326	18	30.0	6	56.5	104.5	94.5	779	689
2	AC Superb	5174	14	3610	3	30.2	8	53.5	106.5	90.0	804	660
3	CDC Go	5277	8	3050	43	42.2	72	52.0	102.0	81.0	1151	599
4	CDC Merlin	3889	77	2274	78	41.5	67	56.5	109.5	108.5	933	968
5	Lovitt	4622	59	2876	62	37.8	46	57.5	105.0	99.0	977	704
6	CDC Bounty	5287	7	3524	5	33.3	18	59.0	103.0	104.5	994	710
7	08WEED1	5453	3	3246	24	40.5	62	55.0	105.5	93.0	1030	792
8	08WEED3	4898	46	3203	28	34.6	24	59.5	103.5	103.5	918	592
9	08WEED5	5331	6	3370	12	36.8	35	55.0	107.5	87.0	1078	781
10	08WEED9	5065	22	2986	52	41.0	65	57.0	107.5	92.5	929	887
11	08WEED14	4618	60	2497	77	45.9	78	54.5	104.5	89.5	977	860
12	08WEED19	5177	12	3231	25	37.6	44	61.0	113.0	114.0	869	789
13	08WEED23	5004	27	3156	33	36.9	37	57.0	102.0	91.0	1063	753
14	08WEED34	5180	11	3022	47	41.7	69	62.0	107.5	115.0	1000	927
15	08WEED36	4472	68	2797	66	37.5	43	55.5	101.0	89.0	1033	1088
16	08WEED37	4827	48	3307	20	31.5	9	61.0	107.0	105.5	1151	741
17	08WEED40	4917	42	3290	21	33.1	17	62.0	107.0	103.5	846	788
18	08WEED44	4760	51	3052	42	35.9	29	57.0	109.0	93.5	1246	743
19	08WEED49	4939	38	3080	39	37.6	45	53.5	102.0	99.0	1035	495
20	08WEED59	4487	66	3154	34	29.7	4	60.0	105.5	104.5	1013	548
21	08WEED63	4944	37	2757	68	44.2	74	56.0	106.5	88.5	1127	1228
22	08WEED71	4968	31	2901	56	41.6	68	59.5	106.0	105.5	1111	919
23	08WEED85	4974	30	3185	30	36.0	31	59.5	108.5	99.5	1029	898
24	08WEED86	3849	78	3010	48	21.8	1	62.5	113.0	112.0	1119	731
25	08WEED100	5065	22	3195	29	36.9	36	58.0	107.0	100.5	970	917
26	08WEED121	5222	9	3176	31	39.2	57	60.0	106.0	110.5	964	877
27	08WEED126	4413	71	2683	70	39.2	58	57.5	102.5	97.5	1201	846
28	08WEED132	4397	73	2598	73	40.9	63	55.5	103.5	101.0	1175	773
29	08WEED134	4781	50	2863	63	40.1	61	58.0	106.5	107.0	998	1012
30	08WEED136	5065	22	3176	32	37.3	42	58.5	108.0	99.5	989	941
31	08WEED138	4915	43	2890	58	41.2	66	57.5	106.5	100.5	898	1007
32	08WEED139	4946	35	3047	44	38.4	51	55.5	105.0	100.5	1090	741
33	08WEED146	4930	39	3225	26	34.6	22	54.5	103.5	99.5	1037	487
34	08WEED147	4728	54	3376	11	28.6	3	53.5	103.0	90.5	861	660
35	08WEED148	4282	76	2926	55	31.7	10	56.5	104.5	100.5	1361	822
36	08WEED149	4674	56	2895	57	38.1	48	55.5	108.0	98.5	1158	803
37	08WEED152	5073	21	3118	36	38.5	54	57.0	108.5	101.5	1204	701
38	08WEED161	4360	74	2694	69	38.2	50	62.0	109.0	106.0	920	828
39	08WEED162	4487	66	2613	71	41.8	70	64.0	112.5	113.0	993	852
40	08WEED176	4720	55	2878	61	39.0	56	57.0	103.5	95.5	767	802
41	08WEED178	4357	75	2791	67	35.9	30	58.5	106.0	103.0	905	926
42	08WEED179	4649	58	2577	74	44.6	76	59.0	108.5	103.0	1076	987
43	08NW6	5463	2	3442	7	37.0	39	57.0	111.0	92.0	873	712
44	08NW7	5595	1	3637	2	35.0	26	56.0	107.0	105.0	745	748

45	08NW15	5425	4	3645	1	32.8	15	57.0	112.0	103.5	910	798
46	08NW21	4432	70	3000	50	32.3	11	62.0	113.0	99.0	1256	798
47	08NW23	4521	64	2997	51	33.7	21	62.0	109.0	96.0	1383	729
48	08NW27	5359	5	3390	9	36.7	34	59.5	109.0	103.5	1074	692
49	08NW28	5091	20	3116	37	38.8	55	58.0	111.0	92.0	843	876
50	08NW30	5094	19	3379	10	33.7	19	58.0	107.0	97.0	859	805
51	08NW42	5019	26	2879	60	42.6	73	58.5	111.0	88.5	1057	892
52	08NW48	4539	63	2888	59	36.4	32	61.5	110.0	108.0	1164	765
53	08NW51	4513	65	3039	45	32.7	14	59.5	108.0	102.5	881	833
54	08NW65	5126	17	3579	4	30.2	7	59.5	104.5	102.5	1043	746
55	08NW68	4904	45	3437	8	29.9	5	58.0	106.0	100.0	1021	509
56	08NW70	4920	41	2966	54	39.7	59	59.0	109.0	97.0	922	1003
57	08NW72	4945	36	3134	35	36.6	33	60.0	108.0	108.0	1091	888
58	08NW76	5197	10	3274	22	37.0	40	59.5	107.5	100.5	969	852
59	08NW80	5136	15	3465	6	32.5	13	58.5	107.5	98.5	940	588
60	08NW86	4407	72	2564	75	41.8	71	62.0	108.0	97.5	1152	996
61	08NW96	4930	40	3336	16	32.3	12	59.0	108.0	98.5	898	792
62	08NW98	4875	47	3001	49	38.5	52	59.5	105.0	100.5	1005	792
63	08NW104	4996	28	3250	23	35.0	25	60.0	108.0	108.0	941	826
64	08NW106	4602	61	2540	76	44.8	77	58.5	110.0	92.5	867	1082
65	08NW109	4978	29	3082	38	38.1	49	61.0	106.5	107.5	1015	867
66	08NW115	4735	53	2838	64	40.1	60	58.5	109.0	107.5	977	882
67	08NW117	4791	49	2972	53	38.0	47	56.0	102.0	102.5	985	787
68	08NW124	4468	69	2815	65	37.0	38	55.0	106.5	96.5	1114	902
69	08NW125	4562	62	3360	13	26.3	2	59.0	107.0	100.0	1019	734
70	08NW131	5127	16	3026	46	41.0	64	57.0	104.0	92.0	846	857
71	08NW135	5032	25	3336	17	33.7	20	58.0	107.0	105.0	864	782
72	08NW144	4960	32	3052	41	38.5	53	59.0	106.0	103.5	877	734
73	08NW153	5177	12	3342	15	35.4	28	57.5	107.5	104.0	1065	756
74	08NW168	4960	32	3218	27	35.1	27	58.0	112.0	105.5	1025	709
75	08NW170	4906	44	3077	40	37.3	41	56.0	110.5	101.5	999	763
76	08NW175	4673	57	2602	72	44.3	75	56.5	104.5	98.5	728	948
77	08NW177	4949	34	3318	19	32.9	16	55.0	104.0	98.5	909	700
78	08NW179	5114	18	3344	14	34.6	23	56.0	108.5	108.5	909	905
	Entry	***		***				***	***	***	***	ns
	Weedsel avg	**4804**		**2999**		**37.4**		**57.9**	**106.3**	**100.4**	**1032**	**821**
	NWeedsel avg	**4931**		**3148**		**36.2**		**58.5**	**107.9**	**100.6**	**978**	**807**
	GRAND MEAN	4865		3076				58.0	107.0	100.2	1000	807
	CV	6.9		13.5				1.3	2.6	4.0	17.7	33.8
	LSD	394		485				1	5	7	207	318
	REPS	4		4				2	2	2	4	4

Table 3. Data for experimental spring wheat lines previously selected under contrasting conditions evaluated under conventional and controlled weed conditions at Saskatoon in 2010.

Entry	Name	NW wheat yield kg/ha	Rnk	Weedy wheat yield kg/ha	Rnk	% redn	Rnk	DSE days	DPM days	Ht cm	Oat kg/ha	Must kg/ha
1	AC Barrie	2730	43	1983	18	27.4	9	50.0	102.5	107.5	613	303
2	AC Superb	2772	39	1556	62	43.9	75	46.5	102.0	92.5	791	376
3	CDC Go	3178	11	1813	39	42.9	74	43.0	100.5	85.0	744	371
4	CDC Merlin	2728	44	1962	22	28.1	10	48.5	102.5	108.5	616	311
5	Lovitt	2977	25	2124	8	28.7	12	48.5	98.5	100.0	679	307
6	CDC Bounty	2722	46	1689	51	38.0	53	51.0	103.5	110.0	778	478
7	08WEED1	3093	16	1863	36	39.8	68	47.0	101.0	105.0	636	371
8	08WEED3	2585	52	1783	43	31.0	21	52.0	106.0	112.0	679	331
9	08WEED5	3061	19	1857	37	39.3	65	47.5	101.0	96.5	667	374
10	08WEED9	3421	2	2271	1	33.6	32	47.0	100.0	101.0	575	336
11	08WEED14	2796	36	1789	42	36.0	47	47.0	100.0	100.0	662	355
12	08WEED19	2374	64	1357	70	42.8	73	51.5	105.5	118.0	928	548
13	08WEED23	3128	14	1893	31	39.5	66	46.5	98.0	95.0	602	424
14	08WEED34	2530	57	1624	56	35.8	45	53.0	104.0	110.5	759	421
15	08WEED36	2888	30	1999	17	30.8	19	48.5	98.5	95.5	613	385
16	08WEED37	2420	63	1775	44	26.7	5	53.5	103.5	105.0	618	381
17	08WEED40	2121	68	1518	63	28.4	11	54.0	104.5	110.0	785	511
18	08WEED44	2788	38	1653	53	40.7	69	46.5	98.0	90.0	776	422
19	08WEED49	3074	17	1940	25	36.9	49	45.5	100.5	106.5	596	288
20	08WEED59	1312	77	1080	74	17.6	1	55.5	112.0	114.5	754	542
21	08WEED63	3059	20	1930	26	36.9	50	47.5	99.0	88.0	745	412
22	08WEED71	3404	3	2134	7	37.3	51	48.0	97.0	104.5	652	367
23	08WEED85	2487	59	1705	49	31.4	23	51.5	103.0	102.0	774	455
24	08WEED86	2026	69	1087	73	46.3	77	53.0	107.5	115.0	915	670
25	08WEED100	2699	47	1971	20	27.0	8	49.5	101.5	109.0	613	366
26	08WEED121	2923	29	1876	34	35.8	44	52.0	103.5	110.0	695	441
27	08WEED126	3269	5	2038	15	37.7	52	49.0	99.5	108.0	643	409
28	08WEED132	3334	4	2057	13	38.3	58	46.5	100.0	108.5	661	458
29	08WEED134	3030	22	1967	21	35.1	40	50.5	100.0	117.0	723	457
30	08WEED136	3212	8	1973	19	38.6	61	50.5	102.5	107.5	594	425
31	08WEED138	2982	24	2023	16	32.2	27	48.5	100.0	101.0	656	352
32	08WEED139	3243	6	2205	3	32.0	26	47.0	99.0	109.0	615	438
33	08WEED146	3154	13	2165	4	31.4	22	44.0	97.0	98.5	666	298
34	08WEED147	2622	51	1917	28	26.9	7	50.5	103.0	101.5	688	434
35	08WEED148	2173	67	1591	59	26.8	6	53.0	104.5	116.0	850	473
36	08WEED149	3068	18	1893	32	38.3	59	47.5	100.0	105.0	758	360
37	08WEED152	3157	12	2160	6	31.6	24	48.0	104.0	110.0	628	365
38	08WEED161	1711	74	1270	71	25.8	4	54.0	112.0	117.0	775	480
39	08WEED162	1265	78	861	78	31.9	25	55.0	112.0	119.0	892	611
40	08WEED176	2552	56	1676	52	34.3	36	49.0	103.5	106.0	607	383
41	08WEED178	2441	62	1584	60	35.1	41	51.0	99.5	105.0	677	345
42	08WEED179	2760	41	1928	27	30.2	18	50.0	103.0	108.0	567	343
43	08NW6	2969	26	2084	11	29.8	15	47.5	101.0	95.5	507	376

44	08NW7	3183	10	2099	9	34.1	33	46.0	99.5	105.0	657	383
45	08NW15	3223	7	2098	10	34.9	39	48.0	101.5	110.0	749	422
46	08NW21	1824	73	1055	75	42.2	71	54.0	111.5	104.5	1184	647
47	08NW23	1858	72	1220	72	34.3	35	54.0	109.5	100.0	999	558
48	08NW27	2454	60	1558	61	36.5	48	52.0	112.0	106.0	657	496
49	08NW28	2569	54	1592	58	38.0	55	50.0	102.5	101.0	688	461
50	08NW30	3124	15	1898	29	39.2	64	47.5	98.0	101.5	682	503
51	08NW42	2256	66	1359	69	39.8	67	52.5	104.5	86.0	865	511
52	08NW48	1677	75	1026	76	38.8	63	51.5	102.5	101.5	966	568
53	08NW51	1904	71	1443	66	24.2	2	53.0	102.5	105.0	827	435
54	08NW65	2000	70	1402	68	29.9	16	53.0	100.5	103.5	777	654
55	08NW68	2832	33	1653	54	41.6	70	51.5	104.0	105.5	772	402
56	08NW70	2574	53	1726	48	33.0	30	50.5	99.5	96.5	716	527
57	08NW72	2638	50	1636	55	38.0	54	52.5	103.0	104.0	750	512
58	08NW76	2855	32	1869	35	34.5	37	51.0	98.5	104.5	653	395
59	08NW80	2505	58	1613	57	35.6	43	52.0	101.0	100.5	790	429
60	08NW86	1632	76	1009	77	38.2	56	54.0	106.0	107.0	883	632
61	08NW96	2817	34	1897	30	32.7	29	51.0	102.5	100.5	676	419
62	08NW98	2932	28	1962	23	33.1	31	51.5	98.5	103.5	692	405
63	08NW104	2650	49	1728	47	34.8	38	51.5	104.5	102.0	630	431
64	08NW106	2446	61	1733	46	29.1	14	50.5	103.5	96.0	779	609
65	08NW109	2724	45	1942	24	28.7	13	52.0	103.5	104.0	740	316
66	08NW115	2793	37	1479	64	47.1	78	48.0	102.0	109.0	739	430
67	08NW117	3054	21	1885	33	38.3	57	47.0	98.5	112.0	664	485
68	08NW124	3433	1	2210	2	35.6	42	46.0	97.5	105.5	612	348
69	08NW125	2766	40	1823	38	34.1	34	51.0	100.5	102.0	684	444
70	08NW131	3188	9	2161	5	32.2	28	48.5	100.0	101.0	689	424
71	08NW135	2997	23	2070	12	30.9	20	51.0	102.5	105.5	580	401
72	08NW144	2335	65	1441	67	38.3	60	52.5	102.5	110.5	805	458
73	08NW153	2887	31	1767	45	38.8	62	47.0	102.5	104.0	663	394
74	08NW168	2662	48	1476	65	44.6	76	50.0	104.5	104.5	749	465
75	08NW170	2808	35	1801	40	35.9	46	46.5	102.5	102.0	681	432
76	08NW175	2564	55	1793	41	30.1	17	47.5	99.0	100.5	616	395
77	08NW177	2962	27	1698	50	42.7	72	45.5	96.5	102.0	541	374
78	08NW179	2741	42	2043	14	25.5	3	46.5	98.0	101.5	501	331
	Entry	***		***				***	***	***	***	***
	Weedsel avg	2727		1789		33.9		49.7	102.3	106.3	696	417
	NWeedsel avg	2647		1708		35.4		50.1	101.3	102.8	714	453
	GRAND MEAN	2694		1754				49.8	102.2	104.3	710	431
	CV	9.23		10.10				1.01	1.35	3.04	14.10	18.58
	LSD	290		207				0.84	2.29	5.27	117	94
	REPS	4		4				2	2	2	4	4

Table 4. Data for experimental spring wheat lines previously selected under contrasting conditions evaluated under conventional and organic conditions at Edmonton in 2009

ENTRY	NAME	Conv wheat yield kg/ha	Rnk	Organic wheat yield kg/ha	Rnk	% redn	Rnk	DPM days	DPM days	Ht cm	Ht cm
1	AC Barrie	3019	35	2965	9	1.8	6	88.8	97.0	69.0	66.5
2	AC Superb	3415	20	3010	8	11.9	15	89.3	97.3	67.5	68.0
3	CDC Go	3044	32	2853	13	6.3	11	90.0	96.3	66.5	64.0
4	CDC Merlin	3208	26	2596	33	19.1	22	91.8	98.0	70.0	78.0
5	Lovitt	2805	37	2621	31	6.6	12	89.5	97.0	76.8	70.5
6	CDC Bounty	2166	42	2524	38	-16.5	1	85.8	92.8	72.0	76.5
7	08WEED1	3042	33	2253	42	25.9	33	88.3	95.0	72.5	72.0
8	08WEED3	3518	17	2591	35	26.3	34	92.3	97.5	78.0	79.0
9	08WEED14	3207	27	2740	20	14.6	16	89.5	96.8	72.5	66.5
10	08WEED23	3305	24	2562	37	22.5	29	89.3	95.8	66.0	63.0
11	08WEED36	2691	38	2719	21	-1.0	4	88.0	94.5	65.0	68.0
12	08WEED37	3322	23	3233	4	2.7	8	91.0	98.8	74.5	76.5
13	08WEED49	3702	9	2922	10	21.1	26	89.5	96.3	76.5	75.5
14	08WEED63	3176	30	2498	39	21.3	28	90.5	94.3	57.0	59.0
15	08WEED86	4364	1	3251	3	25.5	32	92.3	100.5	88.0	83.0
16	08WEED121	3378	21	2713	22	19.7	24	91.0	98.3	78.0	75.5
17	08WEED126	2950	36	2886	12	2.2	7	90.5	97.0	80.5	70.5
18	08WEED136	3824	7	3184	5	16.7	18	92.3	99.3	77.0	72.0
19	08WEED139	3164	31	2917	11	7.8	14	88.0	96.3	75.0	74.5
20	08WEED146	3285	25	2689	25	18.1	21	86.3	95.0	69.5	66.5
21	08WEED152	3459	19	2788	17	19.4	23	90.0	99.0	72.5	67.5
22	08WEED176	3674	10	2624	30	28.6	36	91.5	99.3	71.5	70.0
23	08WEED178	3022	34	2802	16	7.3	13	89.5	96.3	69.5	67.0
24	08WEED179	3875	6	3051	7	21.3	27	91.8	96.8	74.5	71.0
25	08NW6	3758	8	2635	29	29.9	40	92.3	97.5	68.0	64.5
26	08NW7	3651	11	2746	18	24.8	30	90.0	94.5	71.0	72.5
27	08NW15	3589	15	3367	2	6.2	10	95.5	100.3	75.5	70.5
28	08NW21	4176	2	2674	26	36.0	42	95.8	101.0	69.5	73.0
29	08NW27	3530	16	2833	14	19.7	25	92.5	97.5	74.5	73.5
30	08NW48	3489	18	2452	41	29.7	39	95.3	99.0	66.0	63.5
31	08NW51	3638	13	2590	36	28.8	37	91.8	98.8	74.5	70.0
32	08NW65	4166	3	3133	6	24.8	31	88.3	97.5	70.5	73.5
33	08NW76	3184	29	2617	32	17.8	19	89.5	93.8	73.5	63.5
34	08NW96	2651	39	2699	23	-1.8	3	91.3	95.3	73.0	64.5
35	08NW106	3354	22	2746	18	18.1	20	92.8	99.3	63.0	62.0
36	08NW117	3187	28	2697	24	15.4	17	89.8	97.5	76.0	74.0
37	08NW124	2240	41	2491	40	-11.2	2	90.0	94.0	71.5	69.5
38	08NW125	3642	12	3477	1	4.5	9	93.5	98.5	73.0	73.0
39	08NW131	3887	5	2651	27	31.8	41	91.0	96.8	63.0	70.0
40	08NW144	2610	40	2596	34	0.5	5	90.0	93.3	77.0	73.0
41	08NW170	3606	14	2641	28	26.8	35	89.3	96.8	71.5	73.5
42	08NW179	4030	4	2833	14	29.7	38	88.8	99.3	67.0	73.0
	Entry	***		*				***	***	***	***
	Weedsel avg	3387		2801				90.1	97.0	73.2	70.9
	NWeedsel avg	3466		2771				91.5	97.2	71.0	69.8
	GRAND MEAN	3357		2783				90.6	97.0	71.9	70.4
	CV	17.7		14.5				2.8	2.6	8.2	8.1
	LSD	696		472				2.9	3.0	6.9	6.7
	REPS	4		4				4	4	4	4

Table 5. Data for experimental spring wheat lines previously selected under contrasting conditions evaluated under conventional and organic conditions at Edmonton in 2010

ENTRY	NAME	Conv wheat yield kg/ha	Rnk	Organic wheat yield kg/ha	Rnk	% redn	Rnk	Conv DPM days	Org DPM days	Conv Ht cm	Org Ht cm
1	AC Barrie	6529	12	2599	26	60.2	32	96.5	94.8	99.5	95.0
2	AC Superb	6643	7	2448	31	63.1	37	101.0	97.5	90.0	92.0
3	CDC Go	6314	16	2537	29	59.8	28	100.5	96.0	83.5	83.0
4	CDC Merlin	6075	26	2831	17	53.4	18	96.5	96.3	106.0	99.5
5	Lovitt	5829	32	3250	8	44.2	5	95.3	96.3	99.5	101.5
6	CDC Bounty	6094	24	886	42	85.5	42	95.8	96.0	106.0	108.0
7	08WEED1	5709	36	2662	22	53.4	17	94.8	96.8	97.5	97.5
8	08WEED3	6109	23	3633	2	40.5	2	96.5	98.5	109.0	104.5
9	08WEED14	5928	31	2998	16	49.4	10	95.0	97.8	95.0	91.3
10	08WEED23	5576	38	3291	6	41.0	3	93.0	93.0	91.5	86.0
11	08WEED36	6574	10	3232	10	50.8	11	95.3	95.0	98.0	98.0
12	08WEED37	7104	2	3387	4	52.3	15	98.5	101.3	108.5	111.0
13	08WEED49	6447	13	3353	5	48.0	9	96.5	98.0	102.0	99.5
14	08WEED63	6833	3	2739	20	59.9	29	96.5	96.8	87.0	88.5
15	08WEED86	5795	34	2667	21	54.0	19	101.5	102.8	117.8	120.0
16	08WEED121	6663	6	3219	11	51.7	14	98.3	98.0	108.0	110.0
17	08WEED126	6063	28	2592	28	57.2	22	95.0	94.5	102.0	104.0
18	08WEED136	6689	5	2748	19	58.9	26	97.3	97.0	108.5	105.0
19	08WEED139	6238	18	3279	7	47.4	7	94.8	93.5	100.0	98.5
20	08WEED146	6087	25	3203	13	47.4	6	94.0	95.0	96.0	89.5
21	08WEED152	6189	21	2628	25	57.5	23	96.5	97.5	101.5	101.5
22	08WEED176	5823	33	2651	23	54.5	20	97.3	97.0	98.0	101.0
23	08WEED178	5019	41	2164	35	56.9	21	93.5	91.0	99.5	100.5
24	08WEED179	5777	35	3033	15	47.5	8	96.5	95.0	98.5	97.0
25	08NW6	6072	27	3789	1	37.6	1	101.0	98.0	90.0	92.5
26	08NW7	6147	22	3531	3	42.6	4	94.0	96.8	104.5	100.0
27	08NW15	6332	15	2597	27	59.0	27	98.5	99.0	101.5	95.0
28	08NW21	5950	30	1474	41	75.2	41	102.0	103.0	99.5	98.5
29	08NW27	7275	1	2775	18	61.8	35	99.5	101.8	103.5	105.5
30	08NW48	3920	42	1571	40	59.9	30	100.8	100.0	105.5	105.5
31	08NW51	6206	20	2384	33	61.6	33	98.5	93.5	105.0	105.5
32	08NW65	6718	4	2441	32	63.7	38	95.3	93.5	100.0	95.0
33	08NW76	6213	19	2062	37	66.8	39	94.0	94.3	106.0	98.0
34	08NW96	6633	8	2646	24	60.1	31	97.3	97.5	99.5	103.0
35	08NW106	6300	17	2016	39	68.0	40	99.5	98.0	88.0	91.5
36	08NW117	6015	29	2481	30	58.8	24	94.5	96.8	106.5	106.5
37	08NW124	5493	39	2048	38	62.7	36	94.3	93.5	96.0	93.0
38	08NW125	6564	11	3217	12	51.0	13	97.3	97.5	100.0	105.0
39	08NW131	6612	9	3247	9	50.9	12	98.5	97.5	94.5	97.0
40	08NW144	5603	37	2149	36	61.6	34	95.5	98.0	103.0	109.5
41	08NW170	5286	40	2179	34	58.8	25	98.5	96.8	100.5	99.5
42	08NW179	6445	14	3036	14	52.9	16	97.0	94.8	104.0	100.5
	Entry	***		***				***	***	***	***
	Weedsel avg	6146		2971		51.6		96.1	96.6	101.0	100.2
	NWeedsel avg	6099		2545		58.5		97.5	97.2	100.4	100.0
	Grand mean	6140		2707				97.0	96.8	100.2	99.6
	CV	9.22		28.38				1.62	2.03	3.95	6.84
	LSD	663		900				1.8	2.3	4.6	8.0
	REPS	4		4				4	4	4	4

Table 6. Data for experimental spring wheat lines previously selected for competitive ability evaluated under controlled weed conditions at Saskatoon in 2009

Entry	Name	Pedigree	wheat yield kg/ha	Rnk	Oat kg/ha	Mustard kg/ha
1	AC Barrie		1960	7	1838	957
2	AC Superb		1345	33	1597	1271
3	CDC Go		2030	4	1926	879
4	CDC Merlin		1248	35	1333	1218
5	Lovitt		633	39	2119	1636
6	CDC Bounty		2234	2	1693	880
7	09WEED1	BW 256/P99.51-145	1807	14	1840	995
8	09WEED2	BW 259/P00.02-56	1931	8	1751	1100
9	09WEED3	BW 259/P00.02-56	1472	27	1679	1138
10	09WEED4	BW 259/P00.38-39	1719	21	1984	974
11	09WEED5	BW 259/P99.51-145	954	38	2172	1176
12	09WEED6	BW 781/P00.02-56	1622	25	1641	1192
13	09WEED7	BW 781/P00.05-86	1925	9	1966	1203
14	09WEED8	BW 781/P00.06-66	2387	1	1866	1016
15	09WEED9	BW 781/P00.06-66	1742	19	1685	1181
16	09WEED10	BW 781/P00.06-72	2027	5	1441	1060
17	09WEED11	BW 781/P00.06-77	1771	17	1727	1119
18	09WEED12	BW 781/P00.06-77	1654	24	2230	1022
19	09WEED13	BW 781/P00.06-77	1723	20	1796	1044
20	09WEED14	BW 781/P00.38-39	1381	32	2321	1252
21	09WEED15	BW 781/P99.51-41	1792	15	1775	1059
22	09WEED16	BW 781/P99.51-41	1418	29	2190	900
23	09WEED17	BW 781/P99.51-73	2051	3	1572	889
24	09WEED18	BW 781/P99.51-73	1906	10	1863	1120
25	09WEED19	BW 781/P99.51-73	1407	30	1834	1281
26	09WEED20	BW 781/P99.51-73	1810	13	2033	985
27	09WEED21	PT555/W01475	1199	36	1714	1319
28	09WEED22	PT555/W01492	1776	16	2006	893
29	09WEED23	PT555/W01494	1900	11	1863	742
30	09WEED24	PT555/W01496	1743	18	1512	954
31	09WEED25	PT559/W01475	1555	26	1881	1050
32	09WEED26	PT559/W01475	1438	28	1725	1473
33	09WEED27	PT559/W01475	1838	12	1899	1102
34	09WEED28	PT559/W01487	1696	22	1615	1129
35	09WEED29	PT559/W01492	1345	34	1827	888
36	09WEED30	PT559/W01494	1989	6	1610	932
37	09WEED31	PT559/W01494	1082	37	1566	1244
38	09WEED32	BW720//BW252/W98096	1386	31	1969	1228
	Average		1655	23	1817	1092
	Entry		**		ns	ns
	CV		20.25		15.20	23.14
	LSD		566		466	426
	REPS		2		2	2

Table 7. Evaluation of experimental spring wheat lines selected under conventional conditions grown under non-weedy conditions at Saskatoon in 2009

ENTRY	NAME	Pedigree	yield kg/ha	Rnk	DSE days	DPM days	Ht cm
1	AC Barrie		2970	37	61.5	116.5	95.5
2	AC Superb		4624	3	58.0	115.0	90.5
3	CDC Go		3342	34	55.0	113.0	76.5
4	CDC Merlin		3810	20	59.0	115.0	104.0
5	Lovitt		2376	38	62.5	117.5	92.0
6	CDC Bounty		4072	11	61.0	112.5	98.5
7	09NWD1	BW 256/P99.51-41	4245	9	59.5	110.0	98.0
8	09NWD2	BW 259/P00.05-86	3305	35	59.5	116.5	87.5
9	09NWD3	BW 259/P00.02-56	4039	13	61.0	115.5	89.5
10	09NWD4	BW 259/P99.51-145	3818	19	59.5	113.0	88.0
11	09NWD5	BW 259/P99.51-79	4627	2	60.0	113.5	86.5
12	09NWD6	BW 781/P00.02-56	3890	17	58.0	114.5	85.0
13	09NWD7	BW 781/P00.02-56	4553	5	61.5	117.0	89.0
14	09NWD8	BW 781/P00.06-66	3585	28	60.0	117.5	83.0
15	09NWD9	BW 781/P00.06-66	3559	30	57.0	113.5	80.0
16	09NWD10	BW 781/P00.06-77	3890	17	58.0	116.0	94.5
17	09NWD11	BW 781/P00.38-33	3438	33	61.0	116.0	80.0
18	09NWD12	BW 781/P99.51-142	4255	8	61.5	115.0	91.5
19	09NWD13	BW 781/P99.51-145	3752	23	58.5	114.5	90.0
20	09NWD14	BW 781/P99.51-145	4067	12	60.0	114.0	92.5
21	09NWD15	BW 781/P99.51-145	3228	36	57.0	113.5	82.0
22	09NWD16	BW 781/P99.51-145	3473	32	57.0	116.5	83.5
23	09NWD17	BW 781/P99.51-41	4568	4	59.0	117.0	95.0
24	09NWD18	BW 781/P99.51-79	3600	27	57.0	113.0	90.0
25	09NWD19	PT555/99FHB68	3526	31	64.0	117.5	91.5
26	09NWD20	PT555/W01493	5117	1	61.5	116.0	101.0
27	09NWD21	PT555/W01493	4019	16	62.5	117.0	98.5
28	09NWD22	PT555/W01494	3567	29	57.0	113.5	90.0
29	09NWD23	PT559/W01473	3753	22	61.0	114.0	101.0
30	09NWD24	PT559/W01473	4079	10	59.5	107.0	93.0
31	09NWD25	PT559/W01475	4024	15	60.5	115.5	96.5
32	09NWD26	PT559/W01487	4038	14	59.5	114.5	92.5
33	09NWD27	PT559/W01487	4520	6	61.0	116.5	89.5
34	09NWD28	PT559/W01494	3754	21	57.0	112.5	88.0
35	09NWD29	PT559/W01496	4358	7	58.0	109.5	99.5
36	09NWD30	BW720//BW252/W98096	3666	25	61.5	116.5	92.5
37	09NWD31	PT559/BW316	3671	24	58.5	114.0	90.5
38	09NWD32	PT559/BW316	3609	26	58.0	116.0	84.0
	Average		3863		59.5	114.6	90.8
	Entry		*		***	***	***
	CV		14.0		1.3	1.5	3.1
	LSD		909		1.3	3.0	4.7
	REPS		2		2	2	2

Table 8. Data for experimental spring wheat lines previously selected under contrasting conditions evaluated under conventional and controlled weed conditions at Saskatoon in 2010

ENTRY	NAME	Pedigree	NW wheat yield kg/ha	Rnk	Weedy wheat yield kg/ha	Rnk	% redn	Rnk	DSE days	DPM days	Ht cm	Oat kg/ha	Must kg/ha
1	AC Barrie		2545	14	1791	7	29.7	3	50.0	101.0	101.5	520	462
2	AC Superb		2652	9	1712	10	35.4	10	47.0	101.5	95.0	732	396
3	CDC Go		2714	8	1710	11	37.0	14	44.0	101.0	85.5	672	403
4	CDC Merlin		2360	18	1679	13	28.9	2	50.5	99.5	112.0	566	364
5	Lovitt		2576	12	1626	15	36.9	13	50.0	100.0	103.5	780	416
6	CDC Bounty		2351	19	1435	19	38.9	18	51.5	101.5	106.0	784	564
7	09WEED2	BW 259/P00.02-56	3080	3	1927	1	37.5	16	48.0	98.5	105.0	682	529
8	09WEED7	BW 781/P00.05-86	2601	11	1610	16	38.1	17	49.5	102.0	111.5	611	415
9	09WEED8	BW 781/P00.06-66	2641	10	1882	2	28.7	1	48.0	99.0	100.5	587	401
10	09WEED10	BW 781/P00.06-72	2223	20	1395	21	37.3	15	51.5	103.0	107.0	742	448
11	09WEED17	BW 781/P99.51-73	3092	2	1757	8	43.2	21	49.0	101.0	108.0	670	455
12	09WEED18	BW 781/P99.51-73	2553	13	1637	14	35.9	11	49.0	104.0	86.5	819	547
13	09WEED23	PT555/W01494	2871	5	1745	9	39.2	20	51.0	100.0	103.0	649	480
14	09WEED30	PT559/W01494	2741	6	1860	4	32.1	4	46.0	98.0	98.0	737	462
15	09NWD1	BW 256/P99.51-41	2876	4	1819	5	36.8	12	49.0	100.5	103.5	660	465
16	09NWD5	BW 259/P99.51-79	2536	15	1683	12	33.6	7	48.5	100.0	92.5	666	416
17	09NWD7	BW 781/P00.02-56	1590	22	1074	22	32.5	5	52.0	102.5	87.0	828	617
18	09NWD12	BW 781/P99.51-142	2116	21	1422	20	32.8	6	48.5	99.5	89.0	764	481
19	09NWD17	BW 781/P99.51-41	2369	17	1444	18	39.1	19	48.5	103.5	89.5	771	469
20	09NWD20	PT555/W01493	2740	7	1816	6	33.7	8	51.0	101.5	103.5	689	459
21	09NWD27	PT559/W01487	2375	16	1565	17	34.1	9	53.0	104.0	95.0	724	511
22	09NWD29	PT559/W01496	3326	1	1873	3	43.7	22	46.5	100.5	105.0	911	504
	Entry		***		***				***	***	***	***	*
	Weedsel avg		2725		1727		36.5		49.0	100.7	102.4	687	467
	NWeedsel avg		2491		1587		35.8		49.6	101.5	95.6	752	490
	GRAND MEAN		2588		1657				49.2	101.0	99.5	707	466
	CV		9.85		8.64				2.37	1.14	2.33	15.74	18.88
	LSD		301		169				2.0	2.0	4.0	131	104
	REPS		4		4				2	2	2	4	4

Table 9. Thirteen populations grown in parallel model weed and conventional plots at Kernen in 2009 (F5) and 2010 (F6).

Cross	Pedigree	2009 Format	2009 harvest	2010 Format	2010 #hills	2010 harvest
X05.27	BW844/Harvest	bulk	600 spikes	hills	352	10%
X05.28	BW844/PT211	bulk	900 spikes	hills	528	10%
X05.29	BW844/Lovitt	bulk	300 spikes	hills	172	10%
X05.30	BW845/Harvest	bulk	900 spikes	hills	528	10%
X05.31	BW845/PT211	bulk	900 spikes	hills	528	10%
X05.32	BW845/Lovitt	bulk	900 spikes	hills	528	10%
X05.33	BW845/BW865	bulk	combined	bulk	*	600 spikes
X05.34	BW845/W03032	bulk	combined	bulk	*	300 spikes
X05.35	BW845/W03814	bulk	combined	bulk	*	300 spikes
X05.36	BW337/Harvest	bulk	combined	bulk	*	900 spikes
X05.37	BW337/PT211	bulk	combined	bulk	*	900 spikes
X05.38	BW337/BW865	bulk	combined	bulk	*	900 spikes
X05.39	BW337//Alsen/CRGB-O-623.4	bulk	combined	bulk	*	900 spikes

Table 10. Populations grown in hills under weedy and non-weedy conditions at Kernen in 2009 (F6) and 2010 (F7).

Cross	Pedigree	2009 # hills	2010 # hills	2010 harvest
x04.80	BW297/W01100	172	60	15%
x04.81	BW297/W01487	528	180	15%
x04.82	BW297/W02073	528	182	15%
x04.83	BW297/W02074	528	178	15%
x04.84	BW297/W02142	528	178	15%
x04.85	BW297/W02143	528	148	15%
x04.86	BW297/W02200	528	180	15%
x04.87	BW297/W02330	528	180	15%
x04.88	BW297/CRGB-O-623.4	528	180	15%
x04.89	BW297/Choteau	528	182	15%
x04.90	BW297/Outlook	528	178	15%
x04.91	BW297/MT0245	528	180	15%
x04.92	BW297/Hanna	528	180	15%
x04.93	BW297/Freyr	528	180	15%
x04.94	BW297/Knudson	528	182	15%
	Total	**7564**	**2548**	